This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below and choose the interval the simplification is contained within.

$$15 - 20 \div 7 * 13 - (11 * 14)$$

The solution is -176.143, which is option B.

A. $[-140.22, -134.22]$

-139.220, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-181.14, -174.14]$

* -176.143, which is the correct option.

C. $[168.78, 170.78]$

168.780, which corresponds to not distributing addition and subtraction correctly.

D. $[-466, -460]$

-464.000, which corresponds to not distributing a negative correctly.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{9025}{361}}$$

The solution is Integer, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Integer

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to -95.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-54 + 88i}{3 - 4i}$$

The solution is $-20.56 + 1.92i$, which is option E.

A. $a \in [-514.5, -513.5]$ and $b \in [1.5, 2.5]$

$-514.00 + 1.92i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [7, 8.5]$ and $b \in [19, 20]$

$7.60 + 19.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

C. $a \in [-19, -17]$ and $b \in [-22.5, -21.5]$

$-18.00 - 22.00i$, which corresponds to just dividing the first term by the first term and the second by the second.

D. $a \in [-21.5, -19.5]$ and $b \in [47.5, 48.5]$

$-20.56 + 48.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

E. $a \in [-21.5, -19.5]$ and $b \in [1.5, 2.5]$

* $-20.56 + 1.92i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(9 - 8i)(-4 + 3i)$$

The solution is $-12 + 59i$, which is option C.

A. $a \in [-65, -55]$ and $b \in [-5, -2]$

$-60 - 5i$, which corresponds to adding a minus sign in the first term.

B. $a \in [-40, -27]$ and $b \in [-28, -19]$

$-36 - 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [-15, -5]$ and $b \in [57, 61]$

   * $-12 + 59i$, which is the correct option.

D. $a \in [-65, -55]$ and $b \in [5, 6]$

   $-60 + 5i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-15, -5]$ and $b \in [-59, -56]$

   $-12 - 59i$, which corresponds to adding a minus sign in both terms.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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5. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{-20}{2} + 49i^2$$

The solution is Rational, which is option A.

A. Rational

   * This is the correct option!

B. Nonreal Complex

   This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Not a Complex Number

   This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Irrational

   These cannot be written as a fraction of Integers. Remember: π is not an Integer!

E. Pure Imaginary

   This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(10 - 6i)(2 + 4i)$$

The solution is $44 + 28i$, which is option C.

A. $a \in [41, 47]$ and $b \in [-29, -25]$

   $44 - 28i$, which corresponds to adding a minus sign in both terms.

B. $a \in [17, 23]$ and $b \in [-25, -18]$

   $20 - 24i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C. $a \in [41, 47]$ and $b \in [24, 29]$

   * $44 + 28i$, which is the correct option.

D. $a \in [-6, -1]$ and $b \in [50, 53]$

$-4 + 52i$, which corresponds to adding a minus sign in the first term.

E. $a \in [-6, -1]$ and $b \in [-53, -51]$

$-4 - 52i$, which corresponds to adding a minus sign in the second term.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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7. Simplify the expression below and choose the interval the simplification is contained within.

$$6 - 12^2 + 2 \div 16 * 17 \div 13$$

The solution is -137.837, which is option A.

A. $[-137.91, -137.54]$

* -137.837, this is the correct option

B. $[149.66, 150.07]$

150.001, which corresponds to two Order of Operations errors.

C. $[150.15, 150.24]$

150.163, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[-138.24, -137.98]$

-137.999, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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8. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$-\sqrt{\frac{324}{625}} + 25i^2$$

The solution is Rational, which is option E.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

C. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

E. Rational

* This is the correct option!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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9. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{27 - 11i}{4 + 8i}$$

The solution is $0.25 - 3.25i$, which is option E.

A. $a \in [6.5, 8]$ and $b \in [-2, 0.5]$

$6.75 - 1.38i$, which corresponds to just dividing the first term by the first term and the second by the second.

B. $a \in [-0.5, 0.5]$ and $b \in [-261.5, -258.5]$

$0.25 - 260.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [18.5, 20.5]$ and $b \in [-4, -2.5]$

$20.00 - 3.25i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [1.5, 3.5]$ and $b \in [1, 4.5]$

$2.45 + 2.15i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-0.5, 0.5]$ and $b \in [-4, -2.5]$

* $0.25 - 3.25i$, which is the correct option.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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10. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{36}{529}}$$

The solution is Rational, which is option B.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

* This is the correct option!

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $\frac{6}{23}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.
